THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

No. 60. DECEMBER 1862.

XLII.—*On the Phenomena of Motion in the Pseudopodia of the* Rhizopoda, *and especially on the so-called Granular Movement and the supposed Coalescence of the Pseudopodia.* By Prof. Reichert*.

[In the introductory portion of this paper, Prof. Reichert endeavours to controvert what he calls the "sarcode-theory," under which he sees a revival of the old notion of a living primordial slime capable of being produced in some mysterious manner independently of preexisting organisms. As we cannot see that the idea of the nature of "sarcode" generally entertained involves any such opinions as to its origin, this part of the author's paper has been omitted, and the translation commences with his discussion of the motile phenomena presented by the pseudopodia.]

Whilst Ehrenberg, in his investigations of living Polythalamia from the North Sea, declares himself expressly against the coalescence of the filaments emitted by them†, Schultze, in his work 'Ueber den Organismus der Polythalamien' (Leipzig, 1854), places himself entirely on Dujardin's side; and to this view the cell-membrane could not but fall a sacrifice afterwards. According to him, the body of the Polythalamia consists of a formless substance, comparable, as to its consistence, with fluid wax, containing globules imbedded in it here and there. The phenomena of motion in the pseudopodia are described by this author essentially in accordance with Dujardin, but rather more accurately, both with regard to their branching and coalescence and in respect of the so-called granular movement in and upon them. Of the granular movement Schultze speaks as follows:—

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* Monatsbericht der Akademie der Wissenschaften zu Berlin, 1862, p. 406. Translated by W. S. Dallas, F.L.S.

† Abhandl. der Akad. der Wiss. zu Berlin, 1839, p. 106.

"A distinction of membrane and contents does not exist in the filaments (p. 17); observation is against an interior channeled structure in which the larger globules are moved; but the regular flowing to and fro of the contractile substance effects the movement of the granules, and the latter, again, inform us of the movements of contraction. The small granules moreover move with the substance flowing out of the general mass of the body *into* the filaments themselves; the larger ones, on the contrary, appear as corpuscles moving *on* the filaments. The coalescence of two or more filaments, the passage of the granules from one into the others united with it, must also remove all doubts raised as to the nature of the substance of the body of the Polythalamia being such as was assumed by Dujardin."

Soon afterwards a parallel was set up between the supposed granular movements in the pseudopodia of the Polythalamia and the currents in the cells of plants, by Unger and Cohn, and thus the bridge was made by which the theory of the protoplasmic mass was enabled to make good its entry into science.

According to J. Müller, the granular movement in the Polythalamia exactly resembles those in the extended filaments of the Thalassicollæ, Polycystina, and Acanthometræ*. In his description of the phenomena of motion in the filaments of the *Sphærozoa* (p. 7) there is an observation on elongated swellings passing along these filaments like granules, to which I must hereafter refer particularly.

During my residence at Trieste last year, my most ardent desire to become more exactly acquainted, from personal observation, with the phenomena of motion in the pseudopodia of the Polythalamia, which have led to such different views upon the organization of animals, was fulfilled. The sea-mud with the living Polythalamia was procured from the basins which have been shut off in the neighbourhood of Zaole for the manufacture of sea-salt. In this there were a species of *Miliola* and one of *Rotalia* which I did not more particularly determine. The animals were examined under magnifying powers of 300, 500, and 700 diameters.

The first impression made upon me by the phenomena of motion in the pseudopodia was of such a nature as fully to support the descriptions of Dujardin and Max Schultze: it was as if one had to do with a fluid substance readily changing its configuration and course with a constant flow and return of particles. But any one observing the astonishing spectacle, which appears so wonderful from its opposition to evident facts in the organization of animals, without reposing a blind confidence in the correctness of the dogmas of the theory of primordial slime, sarcode, or protoplasm, must admit, after some consideration, that the picture of a fluid and flowing mass may also very easily be produced in separated and not fluid, but solid or semisolid (*festweichen*) masses whenever two conditions are fulfilled :—1, when the surface of such bodies brings an alternate, more or less regular play of elevations before us in such a manner that we are led to conceive a motion like that of waves in water ; and 2, when bodies really separate, but not distinguishable as such at their mutual points of contact, are constantly changing their relative position, and under these circumstances present themselves as a mass varying at pleasure in form and limits, and possessing properties appertaining to fluid substances. From the point of view which I am convinced is to be maintained, if not alone, still especially, in regard to organisms, the impression made by the phenomena of motion in the pseudopodia becomes essentially different ; the lustre of the dogmas respecting the sarcode-theory is very soon lost, and the heresy then becomes clear and unmistakeable.

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* Abhandl. der Akad. der Wiss. zu Berlin, 1858, p. 2.

In order, however, to avoid being misled by the deceptive image, it is necessary in this, as in other cases, to take up the microscopic analysis of the individual filaments, and at first to disregard as much as possible their proteus-like complicated mass. According to my observations upon *the nature of the individual filaments*, the following statements may be made :—

The pseudopodia, which, when fully extended, measure six or eight times the greatest diameter of the body, form at their free extremities (where they may with the greatest certainty be found simple and single), extraordinarily fine filaments, even under the highest powers of the microscope. To give some notion of their fineness the observation will suffice, that a perceptible thickening scarcely appears when two or three filaments come together and apparently fuse into one, or when the magnifying power of the instrument is raised from 450 to 700 diameters. For the same reason nothing definite can be said as to whether they are, as they appear to be, perfectly cylindrical or more or less flattened. They appear to be everywhere of uniform thickness. Apparent or real local thickenings occur in consequence of movements of contraction, to which I must revert hereafter ; I must likewise defer the discussion of the question whether, besides decidedly simple filaments, branched ones occur, issuing from the former by movements of contraction. The individual extended filaments consist of an apparently colourless, transparent, hyaline substance, which at the extreme ends, where they may most readily be observed singly, possesses an index of refraction differing very little from that of the surrounding fluid (sea-water); it is only with the greatest effort and the most favourable light that the extreme ends of the filaments can be traced. Where many pseudopodia lie together, the outlines become sharper and at the same time darker, and, in the animals examined by me, a yellowish coloration makes its appearance. If we leave out of consideration the apparent granules occurring in the so-called granular movement, no globules or corpuscles of measurable size were detected at any time or in any place in or on the pseudopodia. Thicker bundles, engaged either in expansion or contraction, have usually a finely granulated appearance. It cannot, however, be ascertained by direct observation whether this is produced by fine wrinklings and inequalities of the surface, or by fine granules imbedded in the apparently hyaline mass. In the lamellæ and structures like swimming membranes formed by the apparent coalescence of the filaments, a granular habitus is also not unfrequently visible. These granules, however, belong either to the so-called granular movement, or it still remains uncertain whether we have to do with a true granule or with a portion of the filament only altered in its form, and resembling a granule. As the granular marking is always lost immediately when the filaments lie quietly in the extended state, or the granular plates and lamellæ again break up into quiescent extended filaments, it must be inferred that the granular marking is only apparent, and produced by alterations of form in the hyaline filaments.

As regards the important question of the state of cohesion and consistence of the substance of the pseudopodia, direct experiments for the solution of this cannot be instituted. We are therefore compelled to draw conclusions upon the above-mentioned physical property from the behaviour of the filaments during active and passive movements, and during their approximation and separation. Here, in the first place, the fact must be proved that, however the filaments may change their form, bend, twist, apparently coalesce, and again separate, their *original form is finally preserved under all civcumstances,* and undergoes no change. From this it follows that their substance cannot be fluid. Moreover, if we will not blindly trust in the dogmas of the various primordial-slime theories, adopt the erroneous theory of the so-called granular movement, and accept the apparent coalescence of the filaments as a real one without further examination, we shall be compelled, in the presence of the facts adduced, to declare the comparison with fluid wax or with a mucus of similar consistence to be quite untenable. But, from the behaviour of the filaments during changes of their form by active and passive movements, it may with certainty be inferred that their substance must be extraordinarily soft and flexible. I may here indicate especially that the quiescent filaments allow themselves to be readily curved into any form by others which are moving, and then remain in this form until they are brought out of it by their own movements or those of other filaments.

During the mutual displacements of the filaments, and the mutual approximation thereby often produced, another remarkable property shows itself,—namely, their ready adhesion to each other. In consequence of this ready adhesion, it happens that the filaments very commonly issue from the shell in larger or smaller bundles, and only subsequently separate. It is also frequently observed that a filament which has, in consequence of its own movement, got under others and then become quiescent, clings to other moving filaments during their passage, and is carried forward passively with them, not unfrequently like an anastomosis between them.

Phenomena of active Movement in the individual Pseudopodia of the Polythalamia.

To the phenomena of active movement in the pseudopodia of the Polythalamia I refer—

1. The issuing of the filaments from the shell, their extension and retraction.

   If the filamentous pseudopodia, which are originally morphologically simple, could actually become converted into branched forms, and the latter again revert to the original form, this change of form must also have belonged to the category of active movements; but these changes of form, as I shall afterwards prove, are either only apparent or not capable of being established with certainty.
2. A tortuous or vermiform movement, usually somewhat sluggish, of the more or less extended filament, either throughout its whole length or in some section of it.
3. The phenomenon described under the name of "granular movement."
4. A mutual displacement of the filaments, often occurring imperceptibly, by their closer approximation or removal to a greater distance, or also by their separation from a bundle in the general radiary complex, under circumstances which do not allow the detection of the active movements of other filaments as co-operating causes. To the changes in the arrangement and form of the total radiary complex of filaments I would not refer more particularly. In these changes, both active movements of the filaments and passive ones caused by their ready adhesion to each other, participate; and it is often quite impossible to calculate exactly the part taken by each kind of

movement. Nevertheless other observers, especially J. Müller, have indicated the imperceptible mutual displacement of the filaments as a phenomenon of active movement; and the fact must be admitted that such displacements of the filaments do occur, in which neither the other active movements of the filaments themselves nor any causes of motion in the surrounding fluid are perceptible. It is exceedingly probable that the causes lie in active movements which occur concealed within the shell at the base of the filaments.

It will be sufficient to indicate preliminarily that the phenomena of movement referred to, and indeed, as will immediately appear, also the so-called granular movement, are only to be regarded as the visible effects of those changes in the substance of the filaments which are produced by the so-called contractility. Of these changes in the material no trace can be detected by the microscope either here, under apparently very favourable circumstances, or in any other contractile substances; we find ourselves rather only in a position to infer the existence of those invisible movements which occur in the contractile substance itself from the effects produced by them (which become an expression visible to us) in the change of form of contractile structures or in changes of the relative positions of the organs participating in them. The supporters of the sarcode-theory have certainly gone a step further by the manner in which they conceived the granular movement. To them the apparent granule is a portion of body-substance containing globules, which flows out of the shell into the extended filament, and again flows back, thus elongating and shortening the filament, or causing the appearance of lamellæ and islands in the radiary complex of filaments by the local accumulation of sarcode. In sarcode, therefore, we should succeed in seeing what has hitherto been denied to us in other contractile structures. Contraction would thus consist in a movement of the mass of the contractile substance, in a transfer of it from one place to another far distant, and the changes of form in contractile structures occur as a consequence of this. In this way it becomes intelligible how the notion could arise of identifying the currents of fluid in cells with the currents of contraction in the pseudopodia. As it may be demonstrated that the granular movement is not produced by the flowing to and fro of portions of the body-substance of the Polythalamia containing globules, I am saved the trouble of entering more particularly into the further consequences of this conception of the contractile movements of the supposed fluid sarcode and its application to other contractile structures.

The so-called Granular Movement.

With regard to the appearances hitherto known under which the granular movement occurs, I must here give the following indications. Dujardin speaks only of an ebb and flow of body-substance containing globules, in consequence of which the filaments appear uneven and granular. Max Schultze, however, represents the ebbing and flowing mass as advancing partly in, but especially on, the filaments as an apparent granule which contains the larger globules. J. Müller indicates that an internal granular movement, like that in the rays of *Actinophrys*, does not occur in the pseudopodia—that here the granular movement rather resembles a granule advancing on the surface of the filament; and he adds the observation that mucous globules and foreign bodies are also moved to and fro by the granules. In his memoir (p. 7) we also find the following remarkable passage:—"Not unfrequently the filaments are seen to be thickened or swelled here and there, and this elongated swelling (little knot) is seen to advance upon the rays like the granules, which may be referred either to a progressive contraction or to elongation and shortening, but is perhaps connected with the granular current." These words are only thrown out doubtfully, and are not again referred to on other occasions when the movements of the pseudopodia are spoken of; nevertheless they contain an observation which, by further investigation of the phenomena, must have led J. Müller to the same conception of the granular movement as that which I have arrived at by my investigations.

The animal in which I first observed the granular movements exhibited them only on particular filaments, and there were even moments in which the visible extended pseudopodia were quite quiescent. The granular movement appeared to be, as described by Max Schultze and J. Müller, an apparent grain or granule moving to and fro on the surface of the filament. I must add, however, that the movement of the granule was not uniform, but that it appeared to jump forward over the surface, or, at least, showed a tremulous movement. But it struck me as very remarkable that, notwithstanding numerous supposed affluxes of granules, and although it is common enough to see that the quiescent granule at the extremity of the filaments does not return, not a single perceptible quiescent globule could be detected in the entire field of vision, either in the surrounding fluid or in or on the substance of the rays themselves. And yet the sarcode-substance flowing out of the body to the rays should contain globules, and the larger globules should not only effect the protrusion of the flowing mass above the level of the filament, but also cause the optical expression of the granular movement. Therefore body-substance with globules could not have flowed to the rays: the fallacy was evident.

The question now was to trace accurately the apparent grain, the true form of which could not be judged of during motion, at the moment of its formation and disappearance. For this there are plenty of opportunities. The shell certainly prevents the observation of many granules; we cannot say how the apparent granules are produced and lose themselves there; but we cannot assert that they there flow out of or into the substance of the body of the animal. With some attention, however, it is very soon discovered that both the centripetal and centrifugal movement of the granule may commence and terminate at any part of the extended filaments outside the shell. Here the following observations may be made during the appearance of the granule, which has hitherto been considered only in motion. On any spot of the hyaline extended filament, there appears suddenly an apparent thickening of fusiform outline, of somewhat yellowish colour and dark contour; the apices of the spindle lose themselves quite imperceptibly in the neighbouring parts of the filament which have remained unaltered. Soon afterwards it appears as if the spindle became shorter, but thicker and darker in the middle, where it projects more beyond the level of the filament; finally, the extremities of the apparently fusiform thickening disappear from the view, and the elevated central part jumps along upon the surface of the filament in the likeness of a granule. On the cessation of the movement, the granule disappears in exactly the same manner, but in a reversed order.

Any one who has traced the gradual production and cessation of the granular movement will assuredly give up the notion of a truly flowing substance in the pseudopodia—a notion which has been derived from an erroneous transference of the phenomena of contraction visible in the *Amœbæ* to the pseudopodia of the Polythalamia. In these we have evidently extended contractile organs of the Polythalamion, in which no cavity and no true granule, either in or upon it, is to be detected; and the phenomena described in connexion with the granular movement therefore require that the latter, as already hinted at by J. Müller, should be interpreted as a phenomenon of contraction. Our knowledge of visible phenomena of contraction is limited, as already mentioned, to the changes of form occurring in the contractile organs in consequence of invisible movements in the contractile substance itself; and even in this respect the scanty observations upon their structure and texture still leave much to be desired. In the present case, only the contraction-wave which occurs and advances upon the filiform contractile organ, in the form either of a local thickening or of a local curvature and loop-formation, can be referred to.

The first question is, whether the described microscopic appearances suit with the assumption that the contraction-wave is caused by local thickening of the filament suddenly occurring at any point and then advancing further: the apparent granule in the so-called granular movement would then have to be regarded as the thickened point. From a deficiency of observations, nothing can be said as to whether the apparent fusiform thickening of the filament must necessarily precede the formation of a knot-like or grain-like swelling and agrees with the preliminary assumption in regard to the contraction-wave. But it may be affirmed that an advancing knot-like thickening of the filament could not produce the microscopic appearance actually seen—as if a granule advanced by jerks upon the surface. Nor could the microscopical picture be produced even if the local swelling of the filament on all sides were of considerable elevation, forming, as in the case of *Astasia flavicans* observed by Ehrenberg, a circular disk, through the central point of which the unchanged portion of the filament seemed to pass; for, during the progress of such a swelling, the microscopic appearance would be as if a ring were drawn along the filament. There is only one case in which, in my opinion, the contraction-wave in the form of an advancing local thickening could correspond with the microscopic appearances described: the thickening must occur on one side, and in the form of a clubbed process or appendage of the pseudopodium; the club-shaped end would then, as it advanced along the pseudopodium, be especially visible and indeed as an apparent grain, seeming to move along on the surface of the filament. No such contraction-form has, however, hitherto been observed; and its assumption seems to me rather bold.

On the contrary, the granular movement seems to be easily intelligible, and at the same time in perfect accordance with other contraction-forms, both in its occurrence and disappearance and in its progress, if we imagine that the contraction-wave is formed by a loop advancing along the filament, produced in consequence of contractile movements of the substance invisible to us. With this supposition the microscopic appearances during the production and, in reversed order, during the cessation of the granular movement especially correspond; the loop, when just rising, will be seen at first as an elongated swelling, afterwards becoming thicker in the middle, and projecting beyond the level of the filament. The elevated loop will also, in consequence of the refraction of the vertex of the curve, present exactly the appearance of a granule, or roundish or oval corpuscle, lying upon the filament, as is very frequently the case in transverse folds of smooth muscular fibres. Thus it is clear that the loop, when in motion, must appear as a granule progressing on the surface of the filament, and, lastly, that it must present the microscopic image of a jerking granule, as it may be presupposed that the loop, in its continual new formation and disappearance, will not always retain the same elevation, and this will cause the appearance of a vacillation of the vertex of the curve or of the apparent granule.

On the apparent Amalgamation and Coalescence of the Pseudopodia.

Of the phenomena which, it was supposed, justified the conclusion that two pseudopodia of the Polythalamia coalesced on touching, the granular movement has already been discussed and its validity disproved. The other evidence adduced may be referred, 1st, to the absence of visible lines of separation during the immediate contact of two actually or apparently simple pseudopodia; and 2nd, to the variability of the configuration of the entire extended radiating complex of filaments under appearances which it was supposed were only possible by an actual coalescence of the filaments. This must be seen, says Dujardin, to remove all doubt that we have to do with a fluid substance, with a true coalescence of the contractile organs.

In order to estimate correctly the value of this evidence and obtain an unprejudiced notion of the changes of form in the whole system of filaments, the behaviour of two (in most cases only apparently) simple pseudopodia must be studied under different circumstances. Two such filaments lying beside each other longitudinally, or crossing each from any cause, exhibit no line of separation at their point of contact: this is what is directly observed. Does it follow from this that the parts in contact have coalesced? Certainly not. Every microscopist is aware that under certain circumstances two decidedly solid parts, such as cells or fibres, may lie together so that the line of separation is not perceived. Some time since, I observed innumerable *Amœbæ* enclosed in an egg-membrane of *Tichogonia*. Some of them, when flattened, came close together, and at this moment all visible line of separation was wanting; afterwards their bodies became cylindrical, and then a line of separation made its appearance at their point of contact. Is it at all remarkable that the line of separation between two contiguous pseudopodia is not seen, when their outlines are so faintly marked, and they possess an index of refraction differing so little from that of water?

The following observations may be made upon two filaments applied to each other entirely or partially in the direction of their length. The united filaments, except when very thick bundles come together, do not appear thicker than the separate ones; if one of the filaments be shorter than the other, the point at which it terminates is not perceived. From this it follows, as already observed, that we can never say with certainty that any filament is simple. Further, the united filaments, in consequence of active movement in one or both of them, may separate again partly or entirely. By this means an orifice may occur in the united filaments, which closes again in a state of repose; or only the apex of one filament separates from the other, and the united, apparently simple, filament then possesses a branch, and appears branched. My attention having been attracted to this, I could not but ask myself the question, whether the ramifications are not throughout only apparent. From my investigations, this question must be answered in the affirmative. I have met with no case of ramification which could not have been explained in the most natural manner by the protrusion of the extremities of filaments from an apparently simple pseudopodium; nay, the usually sudden shooting forth of such branches is not in favour of their production being effected by movements of contraction.

In two filaments crossing each other at an acute angle, an appearance is observable upon which, as a proof of the coalescence of the pseudopodia, great stress has been laid, especially by Dujardin; the angle is very frequently seen to be occupied by a web-like structure. When the angle is very acute, and the appearance not much diffused, the suspicion that there is some optical illusion cannot be altogether got rid of; in other cases it is seen quite distinctly that the angle formed by the two filaments is occupied by a hyaline or generally finely granular substance. The comparison with a swimming membrane is, however, not quite suitable; for no filament is to be distinguished on the margins or in the region of the apparently membranous structure. From the microscopic appearance, it might equally well be said to be a triangular plate from the angles of which filaments issue.

I will not deny that such a web-like structure may be produced by the overflow of the mass of two fluid filaments approaching each other at an acute angle. But in the present case, taking into consideration our previous knowledge of the morphological conditions of the organization of animals, in order to show that they make their appearance by such a mode of production it must first of all be proved that the filaments consist of a fluid substance; or, if the web-like plate itself is to serve as evidence of the fluid consistence of the pseudopodia, it would have to be shown that their production can be imagined only by truly fluid substances, and not by means of semisolid filaments of the nature described by me.

In vain we seek, in the works of Dujardin, Max Schultze, and other adherents of the sarcode-theory, for any such scientific treatment of the problem before them. The granular movement is at once explained as the optical expression of the ebbing and flowing body-substance; there is no hesitation about inferring from the uniting of the filaments into bundles, without lines of separation, that they coalesce; and when once the notion of the slimy consistence of the sarcode was entertained, the formation of the apparently membranous plates only furnished a fresh proof of the preconceived opinion. The confusion of the observers is so great that it never seems to have been thought worth while to notice the behaviour of the apparently membranous plates during their disappearance, or the movements of the pseudopodia, and thus to raise the question whether the appearances here seen could be brought into accordance with the view set up. Thus, the plate supposed to be fluid and formed by a fresh accession of body-substance disappears without a trace of residuum on the separation of the united filaments; nay, further, the two crossed filaments are seen to be pushed continually to and fro, still retaining their original form, with as much facility as if there existed no such membrane, *i. e.* a spot in their course at which the filamentous structure ceases and in its place a fluid plate is introduced.

On the other hand, in the apparently membranous plates, phenomena are observed from which, according to the above statements regarding the granular movement, we must necessarily infer the presence of filaments in the plates, and consequently the composition of the latter out of filaments. It is well known that the granular movement is perceptible in the apparently membranous plates. The apparent granules are seen to pass from the proximal end of the filament in more or less curved lines through the plates to the peripheral end of the same filament, or *vice versâ*; the granule is also seen to run in a straight or curved line from one filament to the other. And it is further observed that, during the separation of the two contiguous filaments from the webs which as it were distort them, filaments quite distinctly separate and become free. I remember one case in which a filament even separated from the free margin of the membrane, subsequently presented itself as a branch of one of the filaments, and finally became perfectly free as a third filament. Hence we may, or rather must, conceive that the apparently membranous webs and plates are produced in this way: in the pseudopodia, or rather bundles of pseudopodia, which approach each other and cross at an acute angle, some of the filaments are moved out of their place, and pushed together into the angle so as to form an apparent plate. The extraordinary flexibility of these filaments, and their great tendency to adhere to each other, are properties which evidently assist in the formation of such membranes and plates.

It is evident that the conditions for the displacement of the simple filaments contained in two approximated pseudopodia so as apparently to form membranous plates are not limited to the crossing of such pseudopodia under an acute angle: two bundles of pseudopodia merely touching each other with the vertices of their curves, and then again separating a little, will also give rise to the appearance of seemingly membranous plates; and a case has even occurred to me in which an apparently membranous bridge-like union was formed at the spot where the separation of two pseudopodia issuing from one bundle had not quite been completed.

After these explanations, I believe there will not be the least difficulty in the comprehension of the multifarious changes of form in the whole radiary complex of pseudopodia, in which, by local contraction in any section, however small, of each filament, innumerable moving particles may be represented. When the animal extends its pseudopodia, the more simple radiate arrangement predominates; soon afterwards the apparent ramifications commence, and become constantly more numerous. The branches, after issuing or being set free, easily reach neighbouring filaments, apply themselves to these, and then appear as anastomoses. By the multiplication of such apparent anastomoses, those reticulated figures are produced which are known under the name of the sarcode-net. At the same time, when the conditions are favourable, numerous membrane-like structures and bridge-like unions between the filaments become visible. These are more widely stretched the more numerous the filaments or the thicker the bundles which touch each other at the part implicated, and, by the imperceptible displacement of the finer filaments contained in them, furnish a more abundant material for the formation of the apparently membranous plates. The causes of the alterations of form in the general radiary system of the pseudopodia are to be sought chiefly in their movements, either active or passive—*i. e.* produced by the ready adhesion of the filaments to each other; by these are effected the displacements of the innumerable particles in the general radiary system, which are often imperceptible, and limited to the very smallest space. Favourable conditions for the multiplicity of forms, and for their ready and often imperceptible change, are also furnished by the extraordinary number of the filaments and their ready flexibility.

Finally, the appearance produced by these readily moveable and extraordinarily flexible parts in the protean system of filaments, as if a moving fluid substance assumed any form, or spread and poured itself into any shape, is an illusion which is set up especially by the circumstance that individual minute parts which are readily displaceable throughout can never be distinguished at their points of contact.

XLIII.—*Description of a singular Shell from Southern India, allied to* Tanalia; *with Remarks on a Travancore* Batissa, *and on the Himalayan Form* Tricula. By W. H. BENSON, Esq.

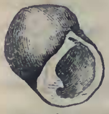
Tanalia(?) *Stomatodon,* Bens., n. sp.

T. testa ovato-globosa, solida, læviuscula (juniorum polita), striis spiralibus obsoletis induta, olivaceo-nigrescente; spira brevi erosa, sutura impressa; anfractibus 3 superstitibus, superioribus convexiusculis, ultimo convexo; apertura ovato-acuta, albida, intus demum angustiore, sinuata; peristomate integro, margine dextro basalique acuto, columellari late calloso, infra latiore, subito intus truncato, dente prominente crasso munito.

Axis 14, lat. 12 mill.

Habitat in aquis dulcibus montium prope Cottyam, regionis Travancoriæ. Invenit D. Kohlhoff.

This very interesting shell was sent to me by Capt. Charles Annesley Benson, at whose request the discoverer had kindly searched the Travancore Hills behind Trevandrum for land and freshwater shells. Among the former was a specimen of *Helix Basileus,* Bens., larger than the type-specimen described in the Annals of Natural History for February 1861.


Tanalia (?) Stomatodon.

The form now made known is a very distinct species of the Paludomoid type; and should it prove to be a *Tanalia,* as surmised by Mr. H. F. Blanford, who has carefully studied the family, it will stand as the first of the genus which has occurred out of Ceylon. Unfortunately, all the specimens were deficient in the operculum, which, when examined, may possibly authorize its transfer to a new genus, in which case the specific name may fairly be employed to designate it. In my remarks on *Clea Annesleyi,* from Quilon, in the Ann. Nat. Hist. for October 1860, I observed that, notwithstanding the basal emargination, *Clea,* with reference to its unguiculate operculum, would probably be found to have nearer relations with the Cingalese genus *Tanalia* than with *Melania* and its congeners. *Stomatodon* seems partly to supply one of the absent links, inasmuch as its operculum must necessarily be provided with a basal projection,